FORM PTO-1390 (REV 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY DOCKET NO. 100210-00002
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		DATE: August 8, 2000
		U.S. APPL. NO. (IF KNOWN, SEE 37 C.F.R. 1.5) 09/601328

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR99/00276	2/9/99	2/9/98

TITLE OF INVENTION: PHOTOCHEMISTRY APPARATUS, IN PARTICULAR FOR MAKING DENTAL PROSTHESES

APPLICANT(S) FOR DO/EO/US: (1) BREDA Charles (2) CUYPERS Pascal

1. X This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
(THE BASIC FILING FEE IS ATTACHED)

2. __ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.

3. __ This express request to begin national examination procedures [35 U.S.C. 371(f)] at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. __ A proper demand for International Preliminary Amendment was made by the 19th month from the earliest claimed priority date.

5. X A copy of the International Application as filed [35 U.S.C. 371(c)(2)]
   a. X is transmitted herewith (required only if not transmitted by the International Bureau).
   b. __ has been transmitted by the International Bureau.
   c. __ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. X A translation of the International Application into English [35 U.S.C. 371(c)(2)].

7. __ Amendments to the claims of the International Application under PCT Article 19 [35 U.S.C. 371(c)(3)]
   a. __ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. __ have been transmitted by the International Bureau.
   c. __ have not been made; however, the time limit for making such amendments has NOT expired.
   d. __ have not been made and will not be made.

8. __ A translation of the amendments to the claims under PCT Article 19 [35 U.S.C. 371(c)(3)].

9. __ An oath or declaration of the inventor(s) [35 U.S.C. 371(c)(4)].

10. __ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 [35 U.S.C. 371(c)(5)].

Items 11 - 16 below concern other document(s) or information included:

11. __ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.

12. __ An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.

13. __ A FIRST preliminary amendment.
__ A SECOND or SUBSEQUENT preliminary amendment.

14. __ A substitute specification.

15. __ A change of power of attorney and/or address letter.

16. X Other items or information: International Preliminary Examination Report; Publication Report
CHECK NO.
Drawings (1 sheet)

U.S. APPLN. NO. . . . . (IF KNOWN SEE 37 C.F.R. 1.5) 09/601328	INTERNATIONAL APPLICATION NO. PCT/FR99/00276	ATTORNEY DOCKET NO. 100210-00002 DATE: August 8, 2000

17. X The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee [37 C.F.R. 1.492(a)(1)-(5)]: Search Report has been prepared by the EPO or JPO.....$880.00 International preliminary examination fee paid to USPTO (37 C.F.R. 1.482).....$680.00 No international preliminary examination fee paid to USPTO (37 C.F.R. 1.482) but international search fee paid to USPTO [37 C.F.R. 1.445(a)(2)].....$750.00 Neither international preliminary examination fee (37 C.F.R. 1.482) or international search fee [37 C.F.R. 1.445(a)(2)] paid to USPTO.....$1,010.00 International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....$ 94.00		

ENTER APPROPRIATE BASIC FEE AMOUNT =				$880.00	
Surcharge of $130.00 for furnishing the oath or declaration later than -- 20 -- 30 months from the earliest claimed priority date [37 C.F.R. 1.492(e)].				$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	18 - 20 =	--	× $ 22.00	$0	
Independent Claims	1 - 3 =	--	× $ 78.00	$0	
Multiple dependent claim(s) (if applicable)			+ $250.00	$250.00	
TOTAL OF ABOVE CALCULATIONS =				$1130.00	
Reduction by one-half for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 C.F.R. 1.9, 1.27, 1.28). -				$	
SUBTOTAL				$1130.00	
Processing fee of $130.00 for furnishing the English translation later the -- 20 -- 30 months from the earliest claimed priority date [37 C.F.R. 1.492(f)]. +				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment [37 C.F.R. 1.21(h)]. The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$1130.00	
				Amount to be refunded	$
				Charged	$

a. X A check in the amount of $1130.00 (Check No. 24834) to cover the above fees is enclosed.
b. Please charge my Deposit Account No. 01-2300 in the amount of $-- _____ to cover the above fee. A duplicate copy of this sheet is enclosed.
c. xx The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 01-2300.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive [37 C.F.R. 1.137(a) or (b)] must be filed and granted to restore the application to pending status.

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09/601328
526 Rec'd PCT/PTO 08 AUG 2000

The invention relates to a photochemistry apparatus serving to expose to luminous radiation, the duration, intensity and spectrum of which can be suitably chosen, objects within which photochemical reactions are carried out. These can involve, for example, biological reactions, or polymer materials that are caused harden using a photo-initiator mixed with the polymers.

Such photochemistry apparatus are used, in particular, to produce false teeth. Such dental prostheses are constituted by a metallic armature coated with a composite made up of successive layers of polymer materials. For each of these layers, the prosthetist, or prosthodontist, chooses the appropriate transparency and opalescence, as a result of which, teeth are obtained that closely resemble the natural teeth of the prosthesis wearer. Characteristically, each of these layers necessitates specific exposure to light the purpose of which is to cause it to harden. In this respect, it is essential to be able to adjust the intensity of the light falling on the object concerned, as well as the duration of exposure. High luminous intensity, for example, is required to harden the opaque materials, such as the one used to mask the metallic armature, or frame, of the prosthesis, or those used for camouflage, and for varnishes or enamels; high luminous intensity is also required for the final firing. Furthermore, it is generally preferable to be able to choose the light spectrum emitted by the sources according to the photo-initiator used, in order to adapt to the wavelengths to which it is the most sensitive.

There is known, for example, an apparatus for photochemically processing dental prostheses according to document GB-2 098 439; the inventors of this apparatus propose, on one hand, placing the prosthesis on a revolving platform to undergo said processing and, on the other hand, using various types of light source, such as mercury vapour lamps and ultraviolet ray lamps.

There is known, from document FR-2 525 470, another apparatus for polymerising plastic materials included in the composition of dental prostheses; in this last-named apparatus, on one hand, the prosthesis to be

processed is placed in a ceramic dish and, on the other hand, flashbulbs, in particular xenon flashbulbs, of a spiral shape, are used as light sources.

Of those apparatus currently in use serving to illuminate dental prostheses during their manufacture, many in fact use xenon discharge lamps, which emit periodic flashes and which are contained in an enclosure, or chamber, in which the object to be hardened is placed. These lamps, however, have serious drawbacks:

- they produce high emissions in the ultraviolet range, whence considerable production of ozone which inevitably pollutes the surrounding area (in which the prosthodontist works), rendering it detrimental to health;
- their useful life is short (about one million flashes, which is equivalent to ten hours or so of use) and, what is more,
- they are expensive.

Use is also made, conventionally, of halogen lamps, which are capable of providing the high luminous intensities required for the opaque materials and the final firing. However, they too have the drawback of a useful life that is short in view of their cost. In addition, as it is necessary, in these known apparatus, to use halogen lamps continuously, there is a risk of overheating in the chamber, which can lead to differential expansion within the multi-layer prosthesis, as well as to damage to the mechanical and electrical components of the apparatus.

Finally in the apparatus of the prior art, the objects to be processed are exposed for the requisite time one by one, which considerably restricts efficiency, that is to say the number of objects produced per hour.

For some time now, so-called "cold cathode" tubes (which have been used hitherto, among other purposes, for illuminating liquid crystal screens), are to be found in this branch of industry; they have the following properties:

- their useful life is at least 10 000 hours;
- the luminance of such a tube is quite stable and, at the end of the life of the tube, begins to decline slowly if no adjustments are made; however, as it can be adjusted via the power supply of the

tube, it can be maintained constant practically throughout the useful life of the tube;

- they can be provided with a luminescent coating, for which a range of products is available, which makes for optimum choice (in relation to the photochemical reactions contemplated) of the wavelengths emitted by the tube (whether provided or not with a luminescent coating); and
- they can be very long.

The invention thus provides a photochemistry apparatus comprising different light sources, at least one of which consists of a cold cathode tube, enclosed in a chamber in which objects within which it is wished to carry out photochemical reactions are placed, and which includes means making it possible to expose said objects to the radiation emitted by said light sources as the preparation of the said objects in view of said photochemical processing progresses while, at the same time, ensuring that each of said objects does indeed receive the total light dose intended.

According to one additional feature of the invention, said means are constituted by an access door and a revolving platform on which said objects are placed, said plate ceasing to revolve and said light sources being turned off automatically for as long as said access door is open.

According to another additional feature of the invention, said sources include tubes of a winding shape, of different luminance values and/or emitting different light spectra, placed end to end, to ensure optimum exposure of the objects (as regards the luminous intensities and light wavelengths) while they are moved within the chamber by means of said revolving platform.

According to yet another additional feature of the invention, the speed of said platform can be adjusted, to permit adjustment of the period for which each object is exposed to light radiation between the time the object is introduced into the chamber and the time it is recovered.

According to yet a further additional feature of the invention, said photochemistry apparatus is equipped with means enabling the light flux emitted by said sources to be varied.

According to yet another additional feature of the invention, said photochemistry apparatus includes a sensor serving to measure the luminous intensity received by said objects, and an electronic regulating device, so as to be able to compensate automatically for the variations in luminance of the sources during their useful life by changing the speed of said revolving platform or the electric power supply of the light sources, or both.

Finally, according to yet a further additional feature of the invention, said photochemistry apparatus has a second revolving platform, smaller than the one mentioned above and mounted on the latter, and an additional light source with a collimated beam, intended for special uses, as well as a control logic, the whole being arranged in such a way that the large revolving platform can take the small revolving platform from a position located opposite said access door to a position located opposite said additional light source.

Further advantages, objects and features of the invention will emerge from the description that follows of the preferred form of embodiment of the invention, said description being based on the annexed figures, wherein:

- Fig. 1 is a perspective view of a photochemistry apparatus according to the invention; and
- Fig. 2 is a side elevation of the photochemistry apparatus illustrated in figure 1.

As can be seen from the figures, the photochemistry apparatus according to the invention is contained in a housing 1. This housing 1 is provided with a door that opens easily, giving access to an inner chamber 5. The objects to be processed (not shown) are placed on a revolving platform 3, and exposed to light radiation from one or more sources 4, which are

disposed in the top of chamber 5. Access door 2 is provided with a filtering window through which the objects to be processed can be seen.

At least one of these light sources 4 is constituted by a cold cathode tube, which has been chosen in such a way that the spectrum of radiation that it emits ensures optimum excitation of the photochemical reaction in question. If need be, several tubes of this type can easily be associated in series, with each one emitting a spectrum of wavelengths differing from that of the other tubes. This series of tubes can be arranged in accordance with the circular movement of the objects borne by revolving platform 3, in such a way that exposure to given wavelengths occurs in a preferential order.

During use, several objects to be processed are introduced into chamber 5, but not necessarily together. Advantageously, each time an object is ready for exposure to light radiation, access door 2 is opened, which automatically causes the movement of revolving platform 3 to be interrupted and sources 4 to be turned off; said object is placed on revolving platform 3; access door 2 is re-closed, which, automatically, re-starts revolving platform 3 and turns sources 4 back on. A given object will have received a known total dose of light energy when revolving platform 3 has rotated by a certain angle (which can be gauged by visually monitoring the displacement of said object); access door 2 is then opened in order to remove it from chamber 5, and access door 2 is re-closed, and so on.

Preferably, each object will be placed and recovered at the most convenient point, namely right opposite access door 2. To permit this, it is clearly necessary for the requisite time for exposure of the objects to radiation to correspond to a full number of turns of revolving platform 3. This is an easy setting to effect when the photochemistry apparatus is equipped with a means (not shown) of controlling the speed of rotation of said revolving platform 3.

It is often necessary to conduct photochemical reactions for which it is advantageous to vary the luminous intensity received during exposure (characteristically, increasing intensity is required). Preferably, therefore, the photochemical apparatus will be equipped with a device for controlling the

electric power supply of sources 4, so as to permit suitable luminance adjustment.

To be perfectly certain that the intensity received by the objects to be processed will indeed be that intended, despite possible variations in luminance of sources 4 (in the main, a decrease due to ageing), the photochemistry apparatus will preferably be equipped with a luminous intensity sensor (not shown), placed in chamber 5. It will then be simple to compensate for such variations (at least up to the complete failure of a source) by adjusting the electric power supply of sources 4, or the speed of rotation of revolving platform 3 (a slowing down of which will permit a longer exposure time), or both. These compensating adjustments can be effected manually or, which is better, automatically, using a suitable logic circuit.

Finally, in the top of chamber 5 is provided an additional light source 7, whereof the beam, the range of which is restricted, is directed towards the rear of chamber 5 in relation to access door 2, so that there is no risk of the radiation emitted by said source 7 reaching the users of the photochemistry apparatus. This additional source 7 is used for special radiation applications. For example, in the case, described above, of the manufacture of dental prostheses, this source 7 is advantageously constituted by a halogen lamp for hardening the opaque materials and for final firing.

To be able to expose a given object to the radiation emitted by said additional source 7, a second revolving platform 6, smaller than first revolving platform 3, is mounted on the latter, with the centre of second revolving platform 6 being placed approximately mid way along a radius of first revolving platform 3.

During use, an object to be processed by means of the radiation emitted by additional source 7 is placed on small platform 6 while the latter is positioned opposite the access door; said object is placed thereon; after the door has been closed, thanks to a special program that has been activated for this purpose, large platform 3 rotates automatically half a turn so a to bring small revolving platform 6 opposite the light beam emitted by additional source 7. Having reached the correct position, small platform 6 comes into

engagement with a gear which causes it to rotate about its axis to permit uniform exposure of said object to said special radiation. At the end of the allotted exposure time, said object is recovered by causing large platform 3 to effect another half turn.

It will be noted that the result of this use of a halogen lamp for special purposes is that the demands made on the lamp are, in practice, infrequent by comparison with those made on known devices, in which the halogen lamps are used to meet all requirements. Consequently, the invention makes it possible to manufacture a large number of objects before it becomes necessary to replace the halogen lamp.

The preferred form of embodiment of the invention has been presented above to serve as an example illustrating the principles of the present invention, but it is quite clear that one skilled in the art can make use thereof to produce other variants of photochemistry apparatus without thereby departing from the invention. For example, it may prove useful, in certain applications, to have a number of additional light sources 7 available, rather than just one, and/or a number of small platforms 6.

As the photochemistry apparatus according to the invention chiefly uses cold cathode tubes, an additional advantage of the invention is that the temperature of the chamber remains moderate; as explained above, this is an appreciable advantage.

In addition, it should be stressed that the photochemical apparatus according to the invention, unlike prior art apparatus using xenon discharge tubes, does not entail any risk to users.

CLAIMS

1. Photochemistry apparatus, in particular for the production of dental prostheses, comprising at least one light source (4) enclosed in a chamber (5) in which are placed objects within which it is wished to carry out photochemical reactions, characterised in that at least one of said light sources (4) consists of a cold cathode tube provided with a luminescent coating, the nature of the latter being chosen according to the applications contemplated for said apparatus.

2. Photochemistry apparatus according to claim 1, characterised in that it includes means (2, 3) enabling said objects to be exposed to the radiation emitted by said light sources (4) as the preparation of said objects in view of said photochemical processing progresses.

3. Photochemistry apparatus according to claim 2, characterised in that said means (2, 3) are constituted by an access door (2) and a revolving platform (3) on which the said objects are placed, said platform (3) ceasing to turn and said light sources (4) being turned off automatically for as long as said access door (2) is open.

4. Photochemistry apparatus according to claim 3, characterised in that said light sources (4) include tubes of a winding shape, of different luminance values and/or emitting different light spectra, placed end to end, for optimum exposure of said objects, as regards the light intensities and light wavelengths, during their circular movement in said chamber (5) ensured by means of said revolving platform (3).

5. Photochemistry apparatus according to claim 3, characterised in that it is equipped with means enabling the speed of rotation of said revolving platform (3) to be varied.

6. Photochemistry apparatus according to any one of the preceding claims, characterised in that it is equipped with means enabling the luminous flux emitted by said sources (4) to be varied.

7. Photochemistry apparatus according to claim 5, characterised in that said photochemistry apparatus includes a sensor serving to measure the light intensity received by said objects, and an electronic regulating device,

so as to be able to compensate automatically for the variations in luminance of said sources (4) during their useful life by changing the speed of said revolving platform (3).

8. Photochemistry apparatus according to claim 6, characterised in that said photochemistry apparatus includes a sensor serving to measure the luminous intensity received by said objects, and an electronic regulating device, so as to be able to compensate automatically for the variations in luminance of said sources (4) during their useful life by changing the electric power supply to said light sources (4).

9. Photochemistry apparatus according to claims 5 and 6, characterised in that said photochemistry apparatus includes a sensor serving to measure the luminous intensity received by said objects, and an electronic regulating device, so as to be able to compensate automatically for the variations in luminance of said sources (4) during their useful life by changing both the speed of said revolving platform (3) and the electric power supply to said light sources (4).

10. Photochemistry apparatus according to claim 3, characterised in that said photochemistry apparatus further includes one or more additional revolving platforms (6), smaller than the first revolving platform (3) and mounted on the latter, and one or more additional light sources (7) with collimated beams, intended for special photochemical reactions, as well as a control logic, the whole being arranged in such a way that the large revolving platform (3) can take each small revolving platform (6) from a position located opposite said access door (2) to a position located opposite the additional light source (7) required for one of said special photochemical reactions.

ABSTRACT OF THE DISCLOSURE

Photochemistry apparatus, in particular for the production of dental prostheses

The invention relates to a photochemistry apparatus comprising at least one light source (4) enclosed in a chamber (5) in which are placed objects within which it is wished to carry out photochemical reactions, in which one, at least, of said light sources (4) consists of a cold cathode tube provided with a luminescent coating, and further including means (2, 3) permitting the exposure of said objects to the radiation emitted by said light sources (4) as the preparation of said objects in view of said photochemical processing progresses.

Application to the production of dental prostheses.

(Fig. 2)

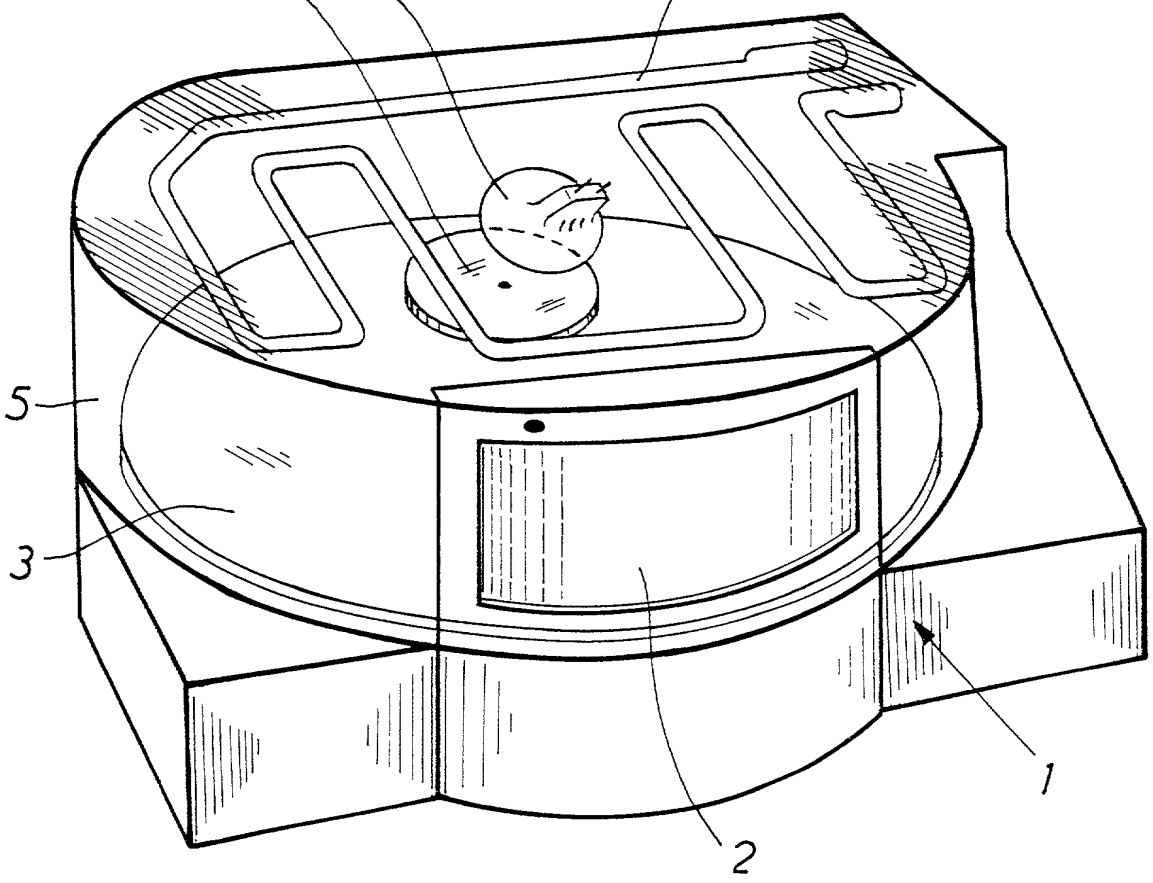

FIG.1

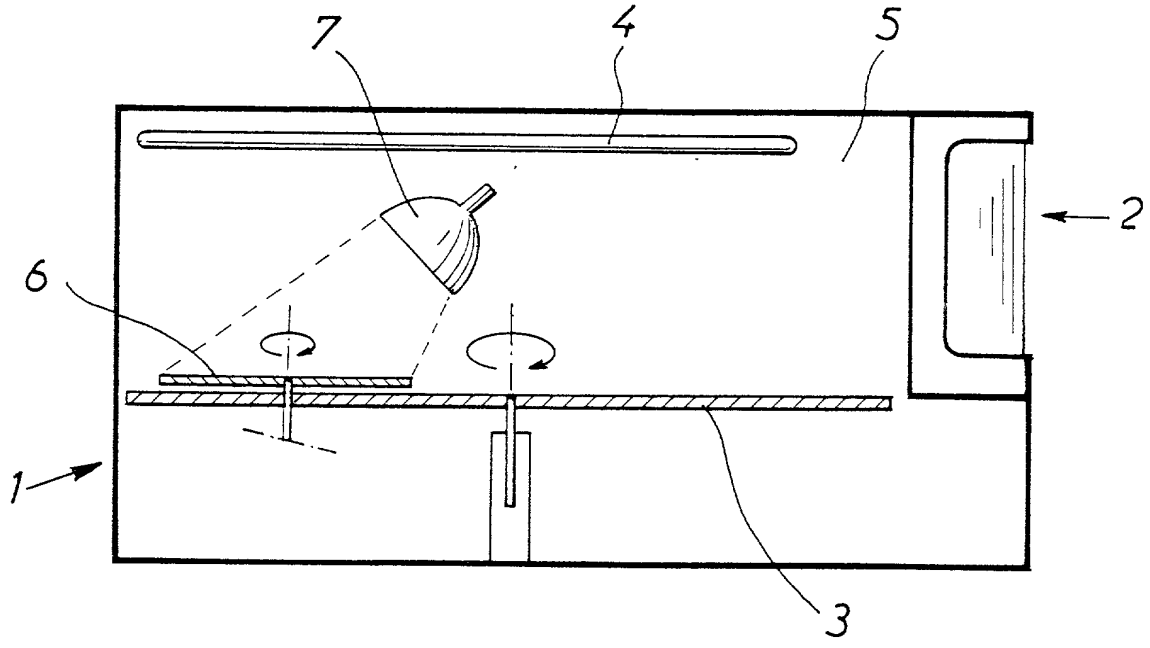

FIG.2

Docket No. 100210-00002

ARENT FOX KINTNER PLOTKIN & KAHN, PLLC
Nikaido, Marmelstein, Murray & Oram Intellectual Property Group

Declaration For U.S. Patent Application

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention **entitled**
(Insert Title) PHOTOCHEMISTRY APARATUS, IN PARTICULAR FOR MAKING DENTAL PROSTHESES

the specification of which is attached hereto unless the following box is checked:

☒ was filed on August 8, 2000 as PCT International Application
Number PCT/FR99/00276 and was amended on _____

and/or was filed on August 8, 2000 as United States Application
Number 09/601,328 and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56.
I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International Application having a filing date before that of the application(s) for which priority is claimed:

				Priority Claimed
(List prior foreign applications. See note A on back of this page)	(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes ☐ No
	(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes ☐ No
	(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes ☐ No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

(Application Number) (Filing Date)

(Application Number) (Filing Date)

(See Note B on back of this page) ☐ See attached list for additional prior foreign or provisional applications.

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) or §365(c) of any PCT International application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) (U.S. or PCT) in the manner provided by the first paragraph of 35, U.S.C. §112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(List prior U.S. Applications or PCT International applications designating the U.S.)	(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
	(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(See Note C on back of this page)

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